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Experimental Study on Voided Biaxial Slab and its Application

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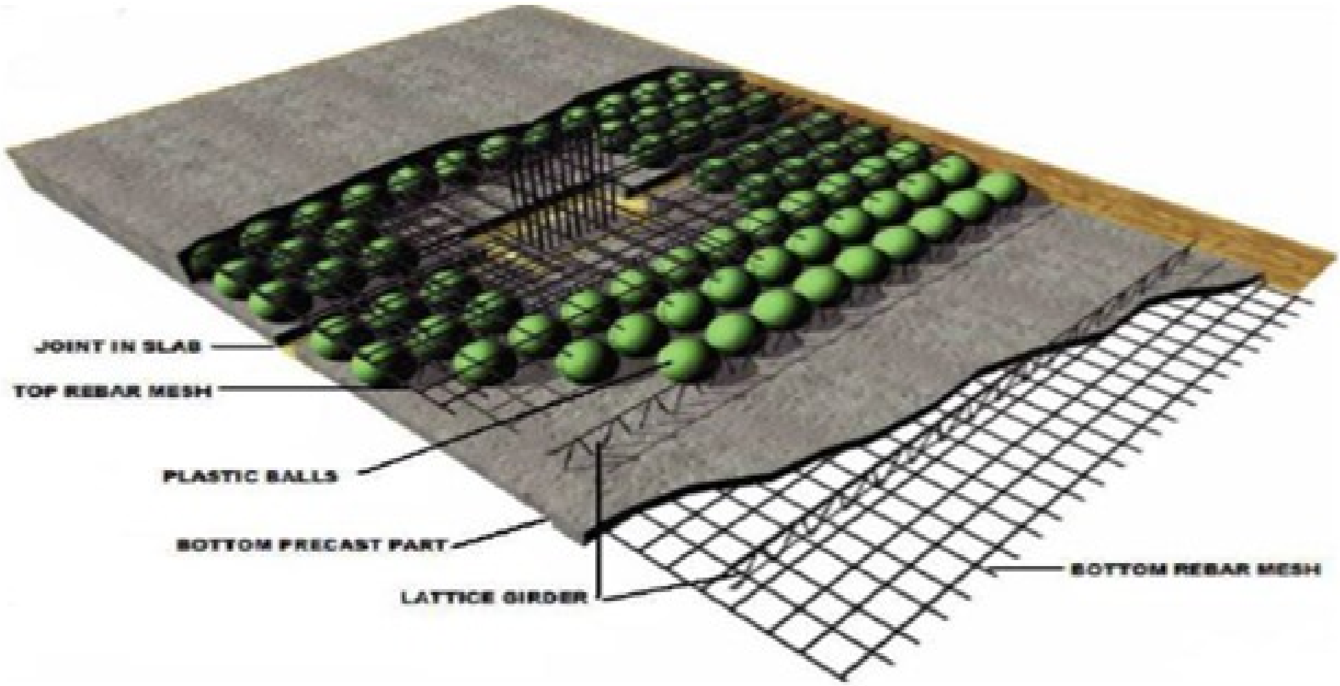
ABSTRACT

Slab is largest member which consumes concrete. If the load acting on the slab is large or clear span between columns is more, the thickness of slab increases. It leads to consume more material such as concrete and steel due to this, self-weight of slab is increased. To avoid these disadvantages voided slab system is used. Reinforced concrete slab with plastic voids is a new and innovative type of construction. It is developed to allow for lighter self-weight of the structure while maintaining similar load carrying capacity of a solid slab. High density polyethylene (HDPE) hollow spheres replace the ineffective concrete from the centre of the slab and decrease the dead load. The advantages are less energy consumption both in production and transport, less emission of exhaust gases from production and transport, especially CO2 and reduce the material, the load, lower the cost and it is also a Green Technology. The Bubble deck slab floor system can be used for storey, roof and ground floor slabs. The effect is to decrease the overall weight by as much as 35% when compared to a solid slab of the same bearing capacity.

INTRODUCTION

Slab is very important member of building construction. It is one of the largest member consuming concrete. The main obstacle with concrete constructions, in case of horizontal slabs, is the high weight, which limits the span. So it is necessary to focused on weakness of the span, reducing the weight or overcoming concrete's natural weakness in tension. In a general way, as the span is increased the deflection of the slab is also increased. Therefore, the slab thickness should be increase. Increasing the slab thickness makes the slabs heavier, and will increase column and foundation size. Thus, it makes buildings uneconomical. To avoid these disadvantages which were caused by increasing of self-weight of slabs, the voided slab system is used.

A voided slab is a concept that simply removes the excess concrete from the expensive part of the structure slab. Bubble deck slab is the application of voided slab. It is a method of eliminating all concrete from the middle of a floor slab, which is not performing any structural function. High density polyethylene (HDPE) hollow spheres replace the ineffective concrete from the centre of the slab and decrease the dead load.



In % of a solid deck	Bubble Deck		
	Same Strength	Same Bending Stiffness	Same concrete vol.
Strength	100	105	150
Bending Stiffness	87	100	300
Concrete volume	66	69	100

By introducing the gaps it leads to 30 to 50% lighter slab. It can also be used as a fire resistant structure. Plastic waste is non–degradable and its disposal has become a matter of great concern to the environment. Bubbles can be created in various forms using recycled plastic. Recycling of plastic waste is of utmost importance to create an eco-friendly atmosphere. Bubble deck system produces floors 20% faster with less formwork, reduces construction costs by 10% and 35% reduction in concrete use.

OBJECTIVES

- Increased load capacity
- Larger spans without beams
- Larger open floor areas
- Resource efficiency
- Economical
- Sound Resistance
- Eco-friendly in nature

SCOPE OF STUDY

The project was done using specimens of size 1m*1m. The support conditions provided are simply supported. Balls of two sizes were only used 80mm diameter and 60mm diameter. Mix of M25 proportion is used after mix design.

LITERATURE REVIEW

Rinku John and Jobil Varghese (2015):- Investigated and identify the methods for reducing the weight of the slab**.** Bubble deck Technology is the innovative system that eliminates secondary supporting structure such as beams reinforced concrete columns or structural walls. Bubble Deck Slab will distribute the forces in a better way than any other hollow floor structures. Bubble Deck behaves like a spatial structure as the only known hollow concrete floor structure, the tests reveal that the shear strength is even higher than presupposed, this indicates a positive influence of the balls.

Sameer Ali and Manoj Kumar (2017):- Concluded that office slab test provides the results of prior research, proving that the Bubble Deck slab performed better than a traditional solid concrete. The maximum stresses and internal forces in the voided deck about to 40% less than the solid slab due to the decreased dead load from the use of HDPE spheres in place of concrete. The deflection of the Bubble Deck slab is slightly higher then the

conventional slab but the stiffness decreases due to the presence of the bubbles.

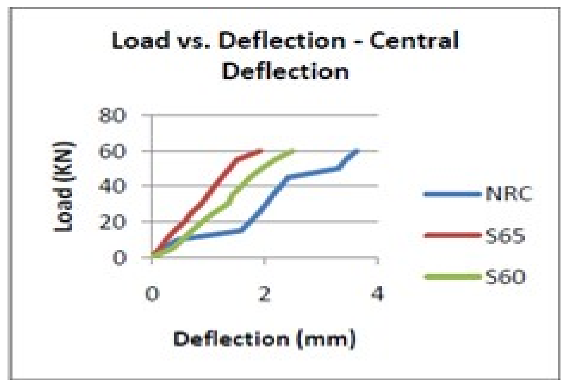
M. Surendar and M. Ranjitham (2016):- The test was conducted to evaluate the structural behaviour of the Conventional slab and Bubble deck slab. Bubble deck slab gives much improved performance than the conventional slab. The numerical and experiment results shows the bubble deck slab can withstand 75% of load carrying capacity when compared to conventional slab. It is observed that the Bubble Deck Slab is better in stress criteria and its weight than that of Conventional slab.

Bhagyashri G. Bhade and S.M Barelikar (2016):- Weight reduction is 25% compared to solid slab. The Bubble Deck is green technology and sustainable avoiding the cement production allows reducing global CO_2 emissions. In comparative of conventional slab the volume of concrete in bubble deck are less required, that is 25% approximately. The Volume of concrete is reduced, so that the weight of slab is decrease, comparative to Conventional slab. Cost and time saving by using bubbles in the slab like weight of slab, concrete volume indirectly load on the beam and walls also decrease less so that building foundations can be designed for smaller dead loads.

Amer M. Ibrahim and Nazar K. Ali (2013):- Studied flexural capacities of two-way bubble deck slabs of spherical voids. It has been verified the flexural behaviour of this Bubble Deck slab such as ultimate load, deflection, concrete compressive strain and crack pattern, two-dimensional flexural tests were tested by using special loading frame. It shows that the crack pattern and flexural behaviour depend on the void diameter to slab thickness ratio. The ultimate load capacities for Bubble Deck slabs having bubble diameter to slab thickness were the same of solid slabs, while when bubble diameter to slab thickness the ultimate capacities were reduced by about (10%).

Shaimaa Tariq Sakin (2016):-
Voided slabs eliminate concrete where it isn't needed. The reduced weight of the slab allows for longer slabs between columns without beams and a reduction in concrete and steel in floors, columns, and footings, saving money and reducing the total building weight, allowing lighter foundation also using recycled material. The uses of SSC increase the punching shear strength and reduce the mid span deflection. Punching shear strength is increased in voided SCC slab and the mid deflection decreased. Adding steel fibre at the critical zone increased the punching strength and reduced the angle of punching failure. The crack pattern of punching shear reduced by use the SCC.

L. R. Terec and M. A. Terec:- The studies have demonstrated that, with the same amount of concrete and the same reinforcement as the solid slab, the bubble deck configuration allows the obtaining of a much-improved flexural capacity and stiffness and a shear capacity of at least 70% from that of a solid slab, realizing 30-50% concrete economy, in comparison with the solid slab. Another advantage of bubble deck system is the significant cost saving.



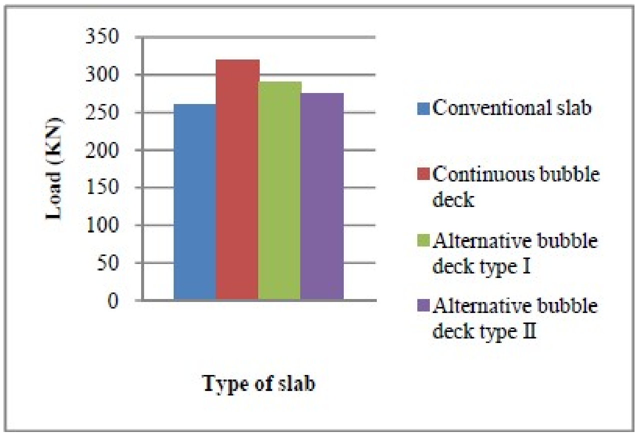
Wondwosen B. Ali and Girum S. Urgessa (2013):-

- ➢ The stiffness for deflection of short span SVBS is considerably less than solid slabs; however, the stiffness becomes almost equal for large span slabs.
- ➢ The flexural capacity of SVBS under uniform load is very close to that of solid slabs, it gets even closer as the span gets longer.
- ➢ The punching shear capacity of SVBS is considerably less than solid slab; hence, the practice of not placing void formers around columns is plausible.
- ➢ Imparting spherical voids around the middle region of the slabs does not significantly compromise the flexural capacity and deflection behaviour of slabs; however, it provides considerable material savings.

METHODOLOGY

1. Basic test on cement, fine aggregate and coarse aggregate.
2. Take 60mm and 80mm diameters spherical balls.
3. Arrange the balls in proper manner with different arrangements.
4. Mix design for M25 grade concrete.

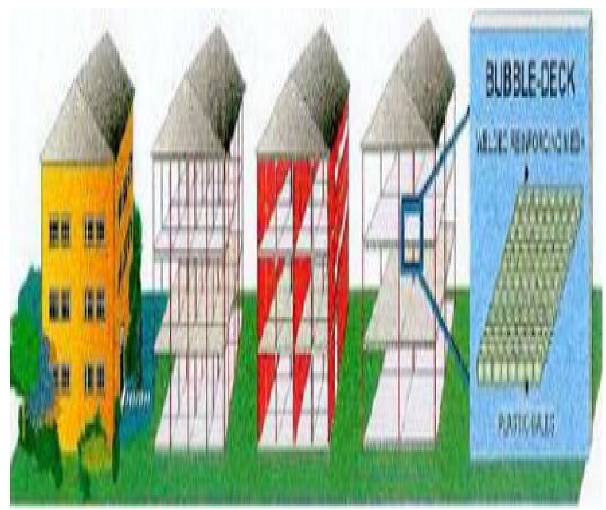
5. Preparation of slab specimens. Prepare 12 slabs (3 of each kind) including 3 conventional slabs as per IS specified.
6. Curing of 7 days must be done.
7. Test the specimen on the machine and take the mean of 3 slabs of same kind for accuracy.
8. Note the result and compare with the conventional slab.



Type of Slab	Load (KN)	Deflection (mm)	Weight (Kg)
Continuous slab	260	8.7	321
Continuous bubble slab	320	9.2	242
Alternate bubble deck type 1	290	8.95	278
Alternate bubble deck type 2	275	8.8	281

CONCLUSION

1) The bubble deck slab can withstand 75% of load carrying capacity when compared to conventional slab. The Bubble Deck Slab is better in stress criteria and its weight than that of Conventional slab.
2) Weight reduction is 25% compared to solid slab.
3) The bubble deck technology is environmentally green and sustainable; avoiding the cement production allows reducing global CO2 emissions.
4) Cost and time saving by using bubbles in the slab like weight of slab, concrete volume indirectly load on the beam and walls also decrease less so that building foundations can be designed for smaller dead loads.
5) In comparative of conventional slab the volume of concrete in bubble deck are less required, that is 25% approximately.
6) Voided slabs eliminate concrete where it isn't needed, the reduced weight of the slab.
7) The stiffness for deflection of short span SVBS is considerably less than when compared to conventional than solid slabs; however, the stiffness becomes almost equal for the large span.
8) The flexural capacity of SVBS under uniform load is very close to that of solid slabs, it gets even closer as the span gets longer.
9) The punching shear capacity of SVBS is considerably less than solid.



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